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# Physicochemical Status of Two Eutrophic Lakes of Bhopal, India: A Comparative Study

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**ABSTRACT**

Bhopal city popularly known as the city of lakes, have eighteen water bodies in Bhopal City. Out of eighteen water bodies, very few are source of drinking water after preliminary treatment. Rest of the water bodies serves secondary purposes like irrigation fisheries and recreational activities etc. Present study concentrates on the physico-chemical status of two eutrophic lakes of Bhopal city. These two lakes are Shahpura Lake & Lower Lake. Shahpura Lake is situated in new Bhopal city where as Lower Lake is situated in old city. Both are eutrophic and sewage fed lake. The study is an attempt of qualitative analysis of the water of two lakes.

**Key words:** Eutrophication, Nutrients, Nitrate, Phosphate, Biological oxygen Demand.

## INTRODUCTION

Bhopal popularly known as the city of lakes, there are eighteen water bodies in Bhopal. Most of them are in advanced stage of eutrophication. Out of eighteen water bodies, few are safe for drinking purpose after preliminary treatment. Rest of the water bodies are used for secondary purposes like irrigation, fisheries, recreational activities etc. Present study concentrates on two eutrophic lakes Shahpura Lake & Lower Lake. Shahpura Lake is situated in new Bhopal city where as Lower Lake is situated in old city, it forms the boundary line between the old city and new city. Both are eutrophic and sewage fed lake. Present study deals with the comparative status of both the lakes. Due to addition of sewage concentration of nutrients increases day by day, this leads to eutrophiction. The lake becomes anaerobic and oxygen demand depletes due to eutrophication.

The Lower Lake, which is one of the twin lakes, is situated midst the thickly populated area of the lake city Bhopal (Lat., $23^0 16' 00'' N$, Long.$77' 25' 00'' E$), the lake was constructed on the seepage Point of Upper Lake. It was constructed by Nawab Chhote Khan in 1974AD. It has a catchments area of 9.60 sq. km. and water spread area of 1.2 sq. km. The lake water is not suitable for drinking it is being used by large number of people living near or around the lake for daily needs of bathing, washing clothes & vehicles. It also forms a dividing line between the old and new Bhopal town. The lake is surrounded by the rows of houses within a hilly terrain the water remains stagnant without any circulation and mixing of the aerated and anaerobic bottom water and increases the sinking rate of the silt particles into the bottom. The whole lake is thus converted into a large septic tank making the lake shallower and shallower day by day. Initially there were 29 point sources by which sewage was mixed into the lake, after the completion of Bhoj Wetland Project some of the point sources are diverted namely Banganga inlet, Dhobighat inlet, Neelam park inlet, Ginnori inlet. Diversion of inlets helps in reducing sewage entry, WQM report (1999). In summer season due to high atmospheric temperature and nutrient concentration, algal bloom was observed. Presence of algal bloom is the main disadvantage of eutrophication. The quality of lake water is deteriorated day by day, Pani *et. al* ( 2000).

Third Lake of Bhopal city is also known as Shahpura Lake or Mansarover Lake. The lake is situated in New Bhopal City, the capital of Madhya Pradesh (La $23^0 12' 00'' E$ and Long.$77^0 25' 30'' N$). The lake has a catchment area of 8.29 $km^2$ and a submergence area of 0.96 $km^2$. This lake is surrounded by human habitation and receives untreated sewage from various point and non point sources. It was constructed in the southern part of city near Chuna Bhatti village in the year 1974-75 under the Betwa irrigation scheme. The lake water has been used for irrigation and fish culture. The major inlet is Panchsheel inlet & beside this it also receives sewage and wastewater through number of unlined drains. The water quality of the lake is deteriorating on account of untreated sewage inflow, siltation, encroachment, excessive growth of weeds, and deforestation in catchments area. The water quality is deteriorating day by day not only sewage inflow, but also by siltaton, domestic sewage, washing of clothes and vehicles and dumping of solid wastes, Tiwari et.al.(2004).

## MATERIALS & METHODS

Samples were collected & preserved seasonally from both the lake as per standard methods mentioned in APHA (1999). After collection of samples were analyzed as per standard methods given in APHA. Identification of sampling points was based on the gratitude & degree of sewage inflow.

## RESULTS & DISCUSSION

### 1. pH

The pH indicates the acidity or alkalinity of water. pH is a important parameter because it controls the state of various nutrients including nitrate, phosphate, dissolved oxygen etc, Goldman, C. *et al*. (1983).

In Lower lake pH ranged between 8.10-12.40 in surface layer whereas in bottom it ranges between 7.17-11.30. Where as in Shahpura Lake it ranges between 6.80-8.42 in surface water, while in bottom layer it ranged between 6.3-8.12. The results of pH value shows that

bottom layer surface water has more pH value. The permissible limit for both drinking and irrigation is 6.0-8.5; De 2002; pp.231-232, hence both the lakes are not suitable for drinking neither for irrigation .

**DISSOLVED OXYGEN**

The dissolved oxygen has a great importance in an aquatic eco-system. It is considered as the pollution indicator parameters. It reflects the biological activity-taking place in a water body and also determines the biological changes, which is due to aerobic and anaerobic organisms. A common observation was that the bottom oxygen demand is low as compare to surface water. Concentration of dissolved oxygen ranged between 8-10.8 mg./l in surface layer and 2.6-7.4 mg./l in the bottom layer. Dissolved oxygen in surface layer of Shahpura Lake ranged between 2.4-9.2 mg./l whereas in bottom layer it was ranged between nil-6.8 mg./l (Fig.2.) Dissolved oxygen in bottom layer generally observed was low because of higher microbial activity, Tamot *et.al*. (1988).

**HARDNESS**

The hardness is governed by the content of calcium and magnesium salts, largely combined with bicarbonates and carbonate. Hardness ranged between 230-264 mg. /l in surface water of Shahpura lake, while in the bottom layer it was ranged between 238.0 -254.0 . In Lower lake total hardness ranged between 141.5-150.0 mg. / l in surface water, whereas in bottom layer it was observed between 142.0-157.50 mg./l. (Fig.3). The Upper permissible limits for irrigation and drinking water are 150.0 and 75.0 mg./l respectively. As per Moyle *et. al.* (1956) all values above 64.0 mg/l come under the category of hard water.

**CHLORIDE**

Presence of chloride is the indicator of pollution either due to organic waste or due to industrial effluents. In Shahpura Lake the concentration of chlorides ranges between 31.90-48.0 mg./l. in surface layer whereas in bottom layer it was observed between 35.90-52.0. In Lower lake concentration of chloride ranged between 32.46-36.21 mg./l in surface layer while in bottom layer it was ranged between 33.22-38.71 mg./l (Fig.4). The upper permissible limit for chlorides in both irrigation and drinking water is 600.0 mg. /l. The levels of chloride reported in both the lakes are within the permissible limits.

**NITRATE**

Nitrate is the important pollution indicator parameter. It is considered as important plant nutrient. It is most oxidized or stable form of nitrogen. In Shahpura Lake it was observed between 1.8-4.5 mg. / l. in surface layer, while in bottom layer it was ranged between 3.2-6.4 mg./l. In lower lake concentration of nitrate ranged between 1.06-2.12 mg./l in surface layers, while in bottom layers it was ranged between 1.46-3.02 mg./l (Fig.5). Higher concentration was observed in bottom layer. The upper permissible limit for nitrate nitrogen for drinking water is 45.0 m. /l. In both the lakes it is found with in the range.

**PHOSPHATE**

In aquatic ecosystem inorganic phosphate as soluble orthophosphate play a dynamic role. The orthophosphates are readily taken up by the phytoplankton or lost to the sediments. In eutrophic lakes high phosphate content supports an increased level of primary

production till nitrogen become limiting. In Shahpura Lake it ranges between 6.8-14.2 mg./l. in surface layer, while in bottom layer it was observed between 8.4-18.9 mg./l. In lower lake phosphate ranged between 1.21-2.33 mg./l.in surface layers while in bottom layer it was observed between 2.13-3.25 mg./l (Fig.6) In both the lake concentration of phosphate crosses the limit of acceptable range. Mehortra, S. (1988) found that the phosphate concentration in surface layer is comparatively lesser than bottom layer.

## BIOLOGICAL OXYGEN DEMAND

The B.O.D. is that fraction of dissolved organic matter, which is degraded and easily assimilated by bacterial population. It is the amount of dissolved oxygen required in mg./l for stabilizing the biodegradable organic matter by microorganisms of the sample under aerobic conditions in a stated time .It is a good index of the organic pollution and helps in deciding suitability of water for human consumption. The upper permissible limit of B.O.D. has been for irrigation and drinking water is 500.0 and 30.0 mg. /l respectively. The B.O.D. of Shahpura Lake ranges between 5.0-18.0 mg. /l. in surface layer, whereas it was observed that in bottom layer it was ranged between 64-102. The BOD of Lower Lake ranged between 11.35-18.20 mg. /l .in surface layer, while in bottom it was observed between 26.70-41.60 (Fig.7). A common trend was observed that in the bottom layer concentration of BOD is higher it might be due to higher microbial activity .BOD is very much related to decomposition of organic matter so that higher the BOD value higher will be the pollution level; WQM report 1999. Dissolved oxygen & BOD both are inversely related to each other Coscun, Y. *et al.* (1987).

**Fig. 1a - Comparative status of pH**

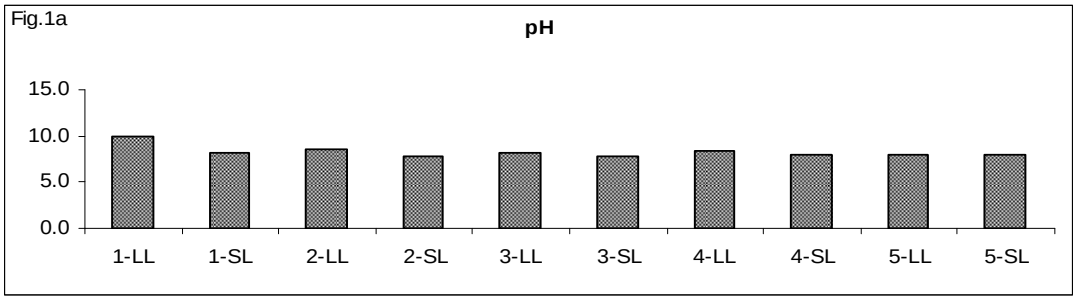



**Fig.1b- Comparative status of conductivity**

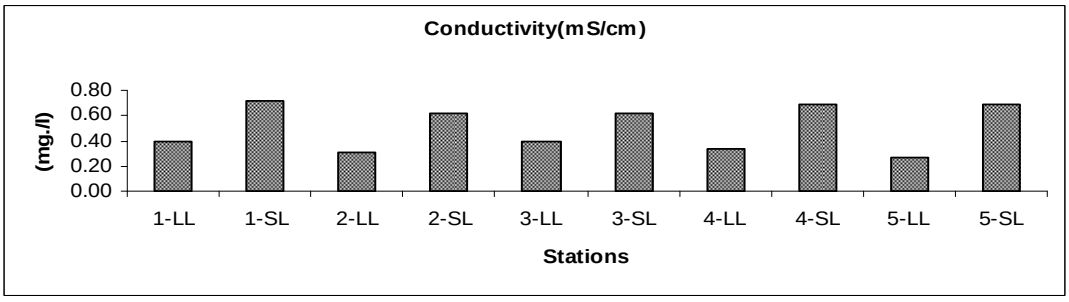



**Fig.1c Comparative status of Total Dissolved Solids**

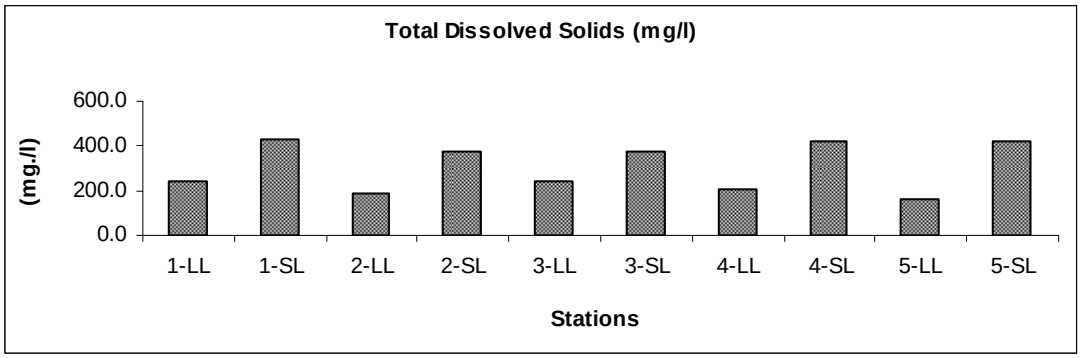



**Fig.1d Comparative status of Biological Oxygen Demand**

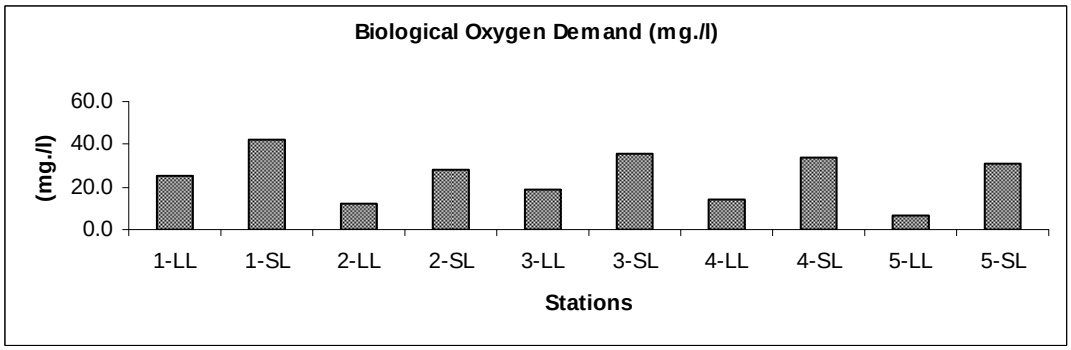



**Fig.2a Comparative status of Nitrate**

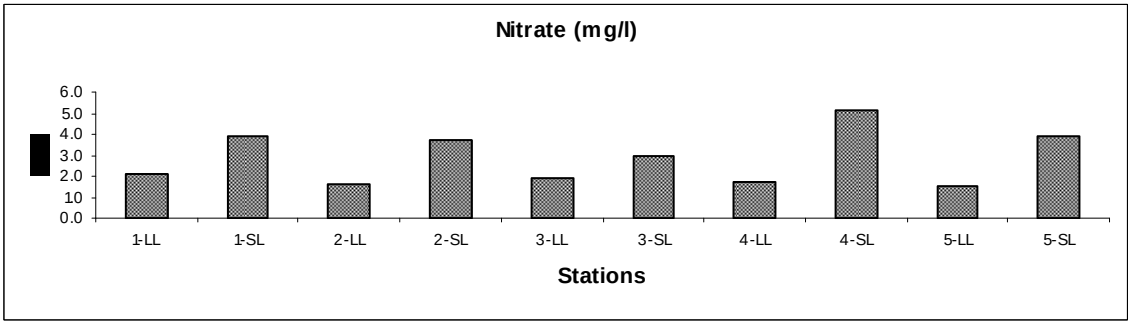



**Fig.2b Comparative status of Phosphate**

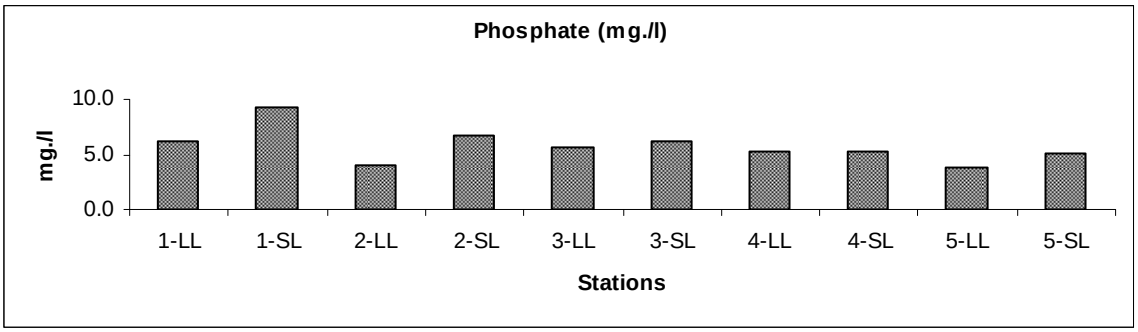



**Fig. 2c Comparative status of Total Hardness**

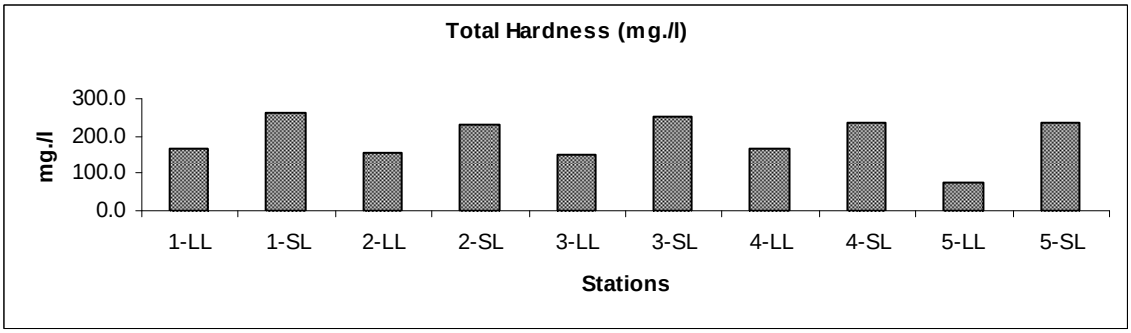
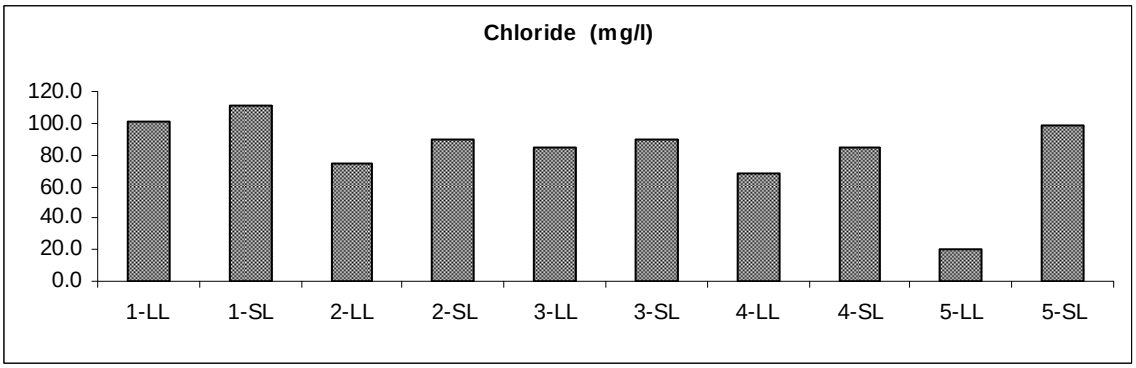



**Fig. 2d Comparative status of Chloride**




SL-Shahpura Lake, LL-Lower Lake

## CONCLUSION

Nitrogen and Phosphorus are considered the most important among nutrients responsible for eutrophication of lake. The results show that nutrient load in both the lakes are very high and hyper eutrophic conditions are observed in Shahapura Lake as well as in Lower Lake of Bhopal. Presence of permanent algal bloom throughout the year in Lower Lake, Bhataganar, G.P.(1984). is the indicator of higher nutrient concentration. Presence of different macrophytes *Eichhornia crassipes, Lemna minor, Azolla sp* in the southern arm of the lake are the indicator of presence of higher concentration of nutrient specially nitrates and phosphates.

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